FISHING BOATS OUT OF STEEL AND CEMENT ("FERRO-CEMENT") WORLD OPINION

R. Balasubramanyan
Central Institute of Fisheries Technology, Craft and Gear Division, Cochin-5

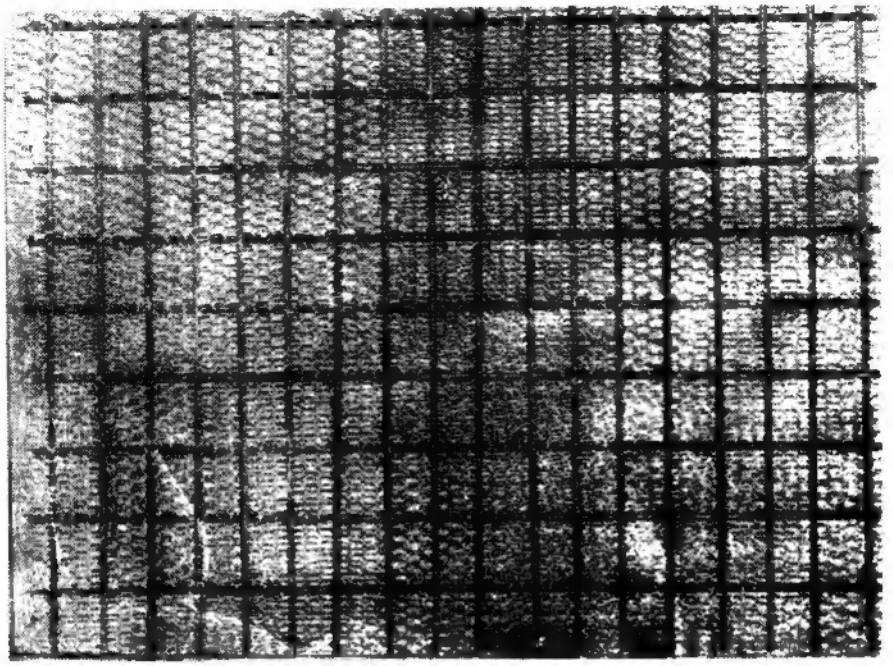
INTRODUCTION

Wood, Steel, Aluminium and Fibreglass Reinforced Plastics (FRP) have been the well known building materials for the construction of modern fishing boats all over the world. To-day, a newer material, a combination of steel and cement, has also come into the field as an alternate material for construction.

"Ferro-cement" or "Ferro-concrete" is the name given to this material which consists essentially of a number of layers of wire mesh and steel rods impregnated with a mortar. The resulting material exhibits all the mechanical properties of an entirely new material so well suited for fishing boat construction with very many advantages over the conventional ones. The material is easy to fabricate into complex shapes without the use of complicated forms and moulds. It has good strength properties and is water proof with greater resistance to sea-water corrosion and other decaying agencies. With very little care and easy maintenance, the ferrocement boats are expected to serve well and last longer than its other counterparts. It is interesting to note that when the prices of conventionally built boats continue in an ever rising spiral beyond the pockets of many, ferro-cement boats can be professionally built for about two-thirds the cost of building a similar vessel out of wood or steel.

HISTORICAL RESUME

Although cement boats caught the public eye and admiration only quite recently, it is rather surprising to know that to-day in the museum at Bringnoles in France, there is a ferro-cement boat built by one M. Jean Lovis Lambot over 120 years ago, which is still in fairly good condition. Similarly a cement boat built 81 years ago is still afloat on the Pelican pond at Amsterdam. "Namsenfjord" the first sea-going reinforced concrete ship was launched in Norway in the year 1917. S. S. "Armistice" was launched in Great Britain in 1919. After this period

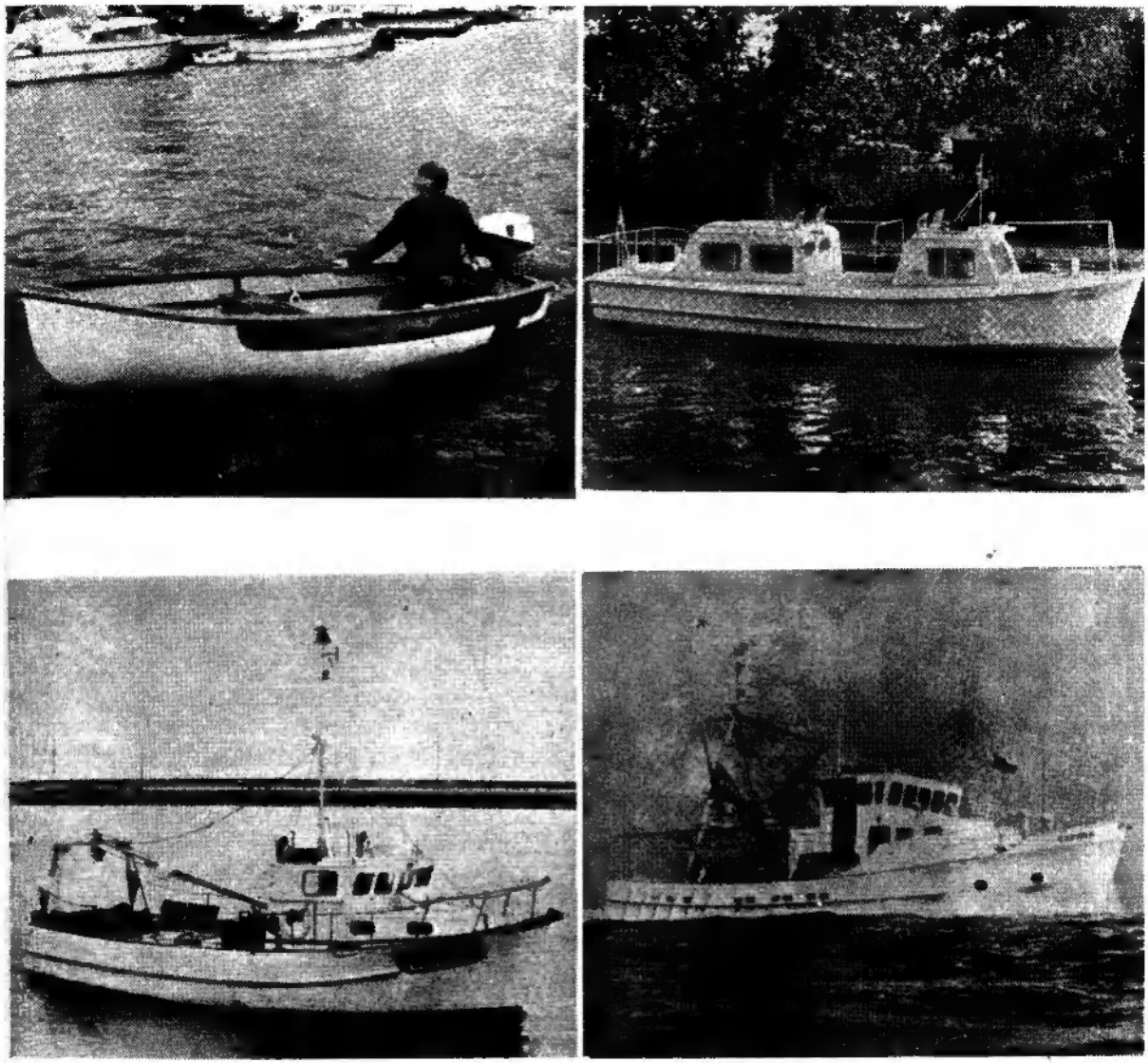


A Panel showing the internal frame work of Steel rods and Chicken wire mesh through which Cement and Sand mixture has to be impregnated.

no evidence of true ferro-cement construction is found except during World War II, when 104 cement vessels and ships ranging in displacement of 4000 tons to 12,750 tons were constructed in the United States of America. In the year 1934, "Rolling Stone", a 30 feet boat with a hull, deck and house of ferro-cement was built in Michigan.

These earlier attempts on cement boats were however not backed by technological findings and experience until 1943 when the real technical beginning of ferro-cement was born. Doctor Pier Luigi Nervi, an Italian civil engineer investigated the properties of ferro-cement in greater details and propounded the following theory : "The fundamental idea behind this new reinforced concrete material "Ferro-cement", is the well known elementary fact that concrete can stand large strains in the neighbourhood of the reinforcement and the magnitude of stress depends on the distribution and sub-division of the reinforcement throughout the mass of concrete". This phenomenon known as the synergistic effect is being further investigated even to-day at many institutes.

Though Dr. Nervi's interest was mainly architectural, yet he decided to try ferro-cement for boat building purposes because he found a particular combination of steel and cement resulted in an enormous strength, light weight, flexibility and low cost building material ideally suited for an aquatic environment. The Italian firm Nervi and Bartoli built the 180 ton motor-sailer "IRENE" as a test vessel within a period of three months and at cost approximately 40% less than the cost of a conventional



Some of the types of "FERROCEMENT" boats

(Courtesy: "SEACRETE")

wooden vessel of the same size. Irene– the world's first 'ferro-cement" ship proved the simplicity of construction and the perfect co-relation between foreseen and actual behaviour of the new material. In spite of steel and cement, Irene was 5% lighter than a conventional wooden vessel of the same size. After years of hard service in the Mediterranean, the prototype never required any maintenance beyond the usual cleaning and painting and is as strong as on the day she was launched.

Nervi went on to build "ferro-cement" vessels, fishing boats, pontoons and yachts using his own theory, specifications and procedures and all worked out well. However, the boat-men of the world had considerable resistance and were sceptic throughout to accept this new building material even after 15 years of successful trials and demonstrations. They were still clinging to wood and steel with a few going in for aluminium and FRP.

THE RENAISSANCE

World conditions took a different turn during 1960's. Conventional wood and steel started showing signs of world scarcity, wood became dear both in quality and their careful maintenance against organic decomposition and deterioration became a serious and ever eluding problem. Corrosion of steel was alarming in all industrial and marine environments more particularly in the tropics. Under these circumstances the whole world was looking for an ideal yet cheaper material with very little problems associated with it. There has been a sudden and sprouting revival of interest in the method of boat construction with steel and cement as propounded and used by Nervi and thus "Ferro-cement" came to limelight.

In the year 1961, both England and New Zealand made pioneering attempts with ferro-cement constructions. M/s. Windboats of England launched a big scheme for the construction of cement boats under their patented trade name "Seacrete". So also M/s. Samson Marine Design Enterprises of Canada who came up with a new technique in the construction. In New Zealand, the first ferro-cement hull of 24 feet length took only nine weeks to complete at a material cost of only £50. In Canada a 30 feet and a 40 feet launch with hull and deck were finished with materials worth only 150 and 300 dollars respectively. In China during 1963 when the scarcity of timber for the construction of their traditional 'sampans' was seriously felt, a company was floated for the successful construction of ferro-cement fishing vessels employing nearly 20 percent of women labour force. Shortly after this, interest spread to North America, British Columbia, California and Florida of the U. S. A. Naval architects started focussing their attention on the speciality of cement boat designs and building engineers started improving construction techniques.

PRESENT STATUS

To-day 'ferro-cement' fishing boats have become popular all over the world and this new construction material has been accepted and approved by Lloyds Register of Shipping, Bureau of Veritas, the United Kingdom White Fish Authority and the Food and Agriculture Organisation of the United Nations. Not only Lloyds approved ferro-cement, but in January 1967, they have produced their own standard rules for all ferro-cement crafts thus giving the new material international recognition. F.A.O. of the U. N. has studied in greater details with prototype constructions, the design and economic aspects of ferro-cement fishing crafts. "Seacrete" of England have offered their patented process of ferro-cement boat construction for worldwide exploitation. Investors from Germany and Japan are reported to have shown considerable interest at the recent Asian Investments Promotion meeting held in Manila, in the Ceylon Project to build a large number of ferrocement fishing boats. Fishing vessels with hulls of ferro-cement are gaining favour in

the waters of Northern Australia and a number of repeat orders have been placed with the builders. "Pak Tak" of Hong Kong (54.5') and "Caranx" of the West Indies (50') are some of the outstanding ferro-cement boats working most satisfactorily to-day in their respective waters.

In India, the credit of building the first ferro-cement fishing boat, "INDCRETE" – a 32' trawler (photo published) goes to a private boat builder M/s. Gamma-n-Gappa Engineering Works of Cochin. The firm is now offering to execute bulk orders at a price 10 to 12 percent cheaper than their wooden or steel counterparts. Under Government agencies, the Fisheries Department of the Tamil Nadu Government has selected designs of 38', 44' and 55' and work is already in progress for their construction entirely out of ferro-cement. The department is also contemplanting construction of ferro-cement boats in connection with the promotion of tourism in their state. A limited number of private organisations in India are now keenly looking into the project feasibilily for the intrcduction of ferro-cement water transports and floating restaurants apart from fishing vessels and harbour crafts. M/s. C. L. Kohli of New Delhi are the licensees for the 'Seacrete' process in India who have a number of designs for ferro-cement hulls including trawlers of varying sizes.

TECHNICAL FEATURES

From an economical point of view, experiences elsewere show that a size range of 40' to 60' ferro-cement hulls are likely to give satisfactory service if constructed on standard sound lines using the approved materials of steel, cement and sand besides clever workmanship. It must be borne in mind that

The first "FERROCEMENT" fishing boat built in India (Cochin)

ferro-cement boat construction under reference differs very much from the conventional Reinforced Cement Concrete (RCC) with which the Civil Engineers are familiar.

Ferro-cement is a very thin ($\frac{3}{4}$" to 1" thickness), highly reinforced slab of concrete with four layers of galvanized-iron chicken wire mesh (20 SWG of $\frac{1}{2}$" hexogonal mesh) firmly fixed on either side of a preformed steel framework consisting of both vertical and horizontal rods of $\frac{1}{4}$" thickness placed 3" x 2" apart as is seen in the accompanying photograph (Fig.). The mortar is a mixture of high quality cement and sand which after careful mixing with water has to be forced through the dense layers of mesh leaving no voids anywhere. The finished structure after curing should be absolutely water proof. The steel content will work out to approximately 35 pounds per cubic foot while the mortar density is 150 pounds per cubic foot. A 50' boat will have a hull thickness of not more than $\frac{3}{4}$" to 1" with a density of approximately 185 pounds per cubic foot (sp. gr. of 2.4 to 2.6). The outside hull will receive suitable paint coatings before launching as a measure of protection against water seepage as well as marine foulants.

The versatility of such a reinforced structure as conceived and introduced by Professor Nervi, has this, in his own words, "there is no danger of warping, rotting, rusting or water logging. A hundred years from now, these boats will be as dry as they are to-day. As for sturdiness, the hulls are a complete monolithic whole. If you strike them, they resound like a bell would. Stress and strains are spread evenly throughout and they are resistant to fire and marine growths". According to Mr. Herman Watzinger, Director of F. A. O.'s Fishery Industries Division, "Ferro-cement is competetive with other materials especially in countries like United Arab Republic where wood is scarce. Ferro-cement boats are quite simple to build and maintain and repairs are easy to make. They are not prey to marine borers which makes them ideal for use in tropical climates. Hulls can be perfectly finished so that they are virtually indistinguishable from other materials".

CONCLUSION

Considering all these facts and figures that go to recomend ferro-cement as a constructional material for fishing boats, we in India have to give a fair trial to this new material. If "ferro-cement" proves to be cheaper and is really economical to maintain such hulls in our tropical waters, we will be free from problems which we are facing now with our conventional materials like wood and steel. Further studies in India may, however, be necessary on specific facts regarding design considerations, construction techniques and strength and durability of ferro-cement structures for newer findings and advancements in this field. The Central Institute of Fisheries Technology at Cochin will be contributing its findings in this line from time to time till "ferro-cement" proves to be an ideal and acceptable alternate substitute to our wooden and steel fishing boats in India.